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DERWENT-WEEK: 199639

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TITLE: Photosensitive recording material for transparent hologram prepd. using solvent-soluble resin and photoinitiators and sensitizing dye

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PATENT-ASSIGNEE: TOPPAN PRINTING CO LTD[TOPP]

PRIORITY-DATA: 1995JP-002802 (January 11, 1995)

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ABSTRACTED-PUB-NO: JP 08190334 A

BASIC-ABSTRACT:

Photosensitive recording material for transparent hologram mtr. by forming a coherent pattern by projecting reference light which is coherent chemical action radiation and object light which is the same radiation to a recording

medium comprises: (A) resin which is solvent soluble and solid at normal temp. and normal pressure; (B) polymerising monomer which has at least one radical polymerisable ethylene unsat. bonding which is liq. at normal temp. and normal pressure and which has b.pt. of 100°C at normal pressure and has different refractive index with the component (A); (C) photo initiator for activating radical polymerisation when it is exposed by chemical action; (D) sensitising dye having amino gp. for sensitising the photo initiator (C); and (E) cpd. for generating sulphonic acid deriv. by action such as light or heat.

USE - The material is used for hologram optical element such as head-up display.

ADVANTAGE - The material has high transparency in a visible light in dry processing and also improved heat resistance and the hologram is chemically stable. In particular, the material is used for photosensitive recording material for transparent hologram for the hologram optical element (HOE) such as the head up display.

TITLE-TERMS: PHOTSENSITISER RECORD MATERIAL TRANSPARENT HOLOGRAM PREPARATION
 SOLVENT SOLUBLE RESIN RADICAL POLYMERISE ETHYLENE UNSATURATED MONOMER PHOTOINITIATOR SENSITIVE DYE

DERWENT-CLASS: A89 G06 P84 V07 W04

CPI-CODES: A12-L02E; A12-L03; G06-D; G06-E; G06-F03C; G06-F03D;
 EPI-CODES: V07-F02C;

ENHANCED-POLYMER-INDEXING:
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 018 ; P0000;
 Polymer Index [1.2]
 018 ; ND01; B9999 B4988*R B4977 B4740; Q9999 Q8673*R Q8606;

B9999

B4386 B4240; Q9999 Q8640 Q8606; Q9999 Q7283; N9999 N7147 N7034
 N7023;
 N9999 N7090 N7034 N7023; B9999 B5447 B5414 B5403 B5276; K9574
 K9483;
 B9999 B4444 B4240; B9999 B4397 B4240; B9999 B4580 B4568; B9999
 B4682
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 Polymer Index [1.3]
 018 ; D12 D10 D01 D53 D51 D54 D55; A999 A179 A157; B9999 B4444
 B4240;
 B9999 B5572*R; A999 A771;
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 Polymer Index [2.2]
 018 ; ND01; Q9999 Q7114*R; Q9999 Q7283; N9999 N7147 N7034
 N7023;
 K9574 K9483; Q9999 Q8640 Q8606;

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刷株式会社内

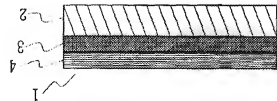
東京都台東区台東1丁目5番1号 凸版印

刷株式会社内

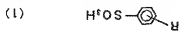
(54) 【発明の名称】 透明ホログラム用感光性記録材料および透明ホログラム用感光性記録媒体並びにそれを用いた透

明ホログラムの製造方法

【目的】 乾式処理によるホログラム形成が可能であり、
高透明性であるとともに耐熱性に優れ、かつ高解像度、
意図折効率、再生波長再現性に優れた透明ホログラムを
提供する。
【構成】 (A) 溶媒可溶性で常温、常圧で固体である樹
脂と、(B) 常温、常圧で液体で、かつ常圧で沸点が1
00℃以上であるラジカル重合可能なエチレン性不飽和
結合を少なくとも1個以上有し、かつ(A)と屈折率の
異なる重合性モノマーと、(C) 露光するとラジカル重
合を活性化する光開始剤と、アミノ基を有する増感色素
と、(E) 光感イオン性などの外的作用によりラジカル重合
誘導体を生じる化合物から構成され、(E) 化合物か
ら生成されるラジカル重合誘導体により、記録媒体中に残
留する増感色素がラジカル重合誘導体によって退色する。



[illegible]

[illegible][illegible]

*を測定したものであり、またT-2は、さらに150℃

で1時間加熱した後の可視光域(400~700 nm)におけるシートの平均透過率を測定したものである。な

お、D、E、およびR、I、Cはそれぞれ回折効率、屈折率変動を示す。

【0042】

【参考】

第 1 组	第 2 组	第 3 组	第 4 组	第 5 组	第 6 组	第 7 组	第 8 组	第 9 组	第 10 组
1.2~2.5%	2.5~5.0%	5.0~9.9%	10.0~19.9%	20.0~29.9%	30.0~39.9%	40.0~49.9%	50.0~59.9%	60.0~69.9%	70.0~79.9%
0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0
0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5
0.02	0.05	0.07	0.1	0.12	0.15	0.18	0.2	0.22	0.25
0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.1

Iに示す。ただし、 $T=1$ は、光を照射した後の可視光域(400~700nm)におけるシート平均透過率*

$\{4 - \{x \text{ かつ } y\}\} - \{x \text{ なら } y\}$
 $\{2 - (3 - x \text{ なら } 2 - y \text{ なら } y \text{ なら } x)\}$
 $\{x \text{ かつ } y\} - \{x \text{ なら } y\}$

透過率を測定した。これを実施例1の結果と合わせて表

1に示す。ただし、T-1は、光を照射した後の可視光域(400~700nm)におけるシートの平均透過率

※を用い、さらにトリエチレングリコールジブチレート 20 の代わりに KAYARAD-R551 (商品名日本化薬社製)を用いる以外は、実施例 1 と同様にホログラムを

た。その評価結果を表2に示す。ただし、 $T-1$ は、1

0.0℃で30分間加熱処理した後に高圧水銀灯で100 mJ/cm²の光照射を行なった時の可視光域(400

～700 nm) におけるシート の平均透過率を測定した
ものであり、また T-2 は、さらに 150℃で 1 時間加

熱した後の可視光域 (400~700 nm) におけるシートの平均透過率を測定したものである。

【0045】

【表2】

测点编号	测点位置	距光源 (m)	照度 (lx)	照度均匀度 (%)
测点6	DY-e-1	2.0	15.4	9.1
测点7	DY-e-2	2.0	15.1	9.2
测点8	DY-e-3	2.0	15.2	9.5
测点9	DY-e-4	2.0	16.3	9.8
测点10	DY-e-5	2.0	14.8	9.7

7」 油化シエルエボキシ社製」の代わりには酢酸ビニル

地盤色(①)	(ml/cm^3)
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20	Dye-1	染料6
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20	Dye-3	染料例8
20	Dye-2	染料例7

20	Dye-4	染料第4
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20	2008-3	2008-3
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電話 03-3403-0001 111-111 111-111 111-111

処理した後に130°Cで10分間加熱処理を行った時

の可視光域(400~700nm)におけるシート平均透過率を測定したものであり、またT-2は、さらに

150℃で1時間加熱した後の可視光域(400~700 nm)におけるシートの平均透過率を測定したもので

* 96

1041
1001

（鏡）を生成させた。これも同様にボロクラムの一つの平
与透過率、回折効率、屈折率変動を測定した。これを表★

【0052】比較例6-10の実例11に示すように、2-フェニルエチルアルコールを添加しない以外は例6-10と同様に作製し、同様に可視光線（400〜700 nm）における平均透過率を測定したものであり、また2-フェニルエチルアルコールを添加しない以外は例6-10と同様に作製し、同様に可視光線（400〜700 nm）における平均透過率を測定したものである。これは比較例1-5と同様に回収物に示す。ただし、T-11は、100℃で30分間加熱後、50℃で30分間加熱し、その評価結果を表6に示す。

[illegible][illegible]

試驗項目	單位	試驗結果	規格要求
試驗項目 1	試驗結果	試驗結果	規格要求
試驗項目 2	試驗結果	試驗結果	規格要求
試驗項目 3	試驗結果	試驗結果	規格要求
試驗項目 4	試驗結果	試驗結果	規格要求
試驗項目 5	試驗結果	試驗結果	規格要求
試驗項目 6	試驗結果	試驗結果	規格要求
試驗項目 7	試驗結果	試驗結果	規格要求
試驗項目 8	試驗結果	試驗結果	規格要求
試驗項目 9	試驗結果	試驗結果	規格要求
試驗項目 10	試驗結果	試驗結果	規格要求
試驗項目 11	試驗結果	試驗結果	規格要求
試驗項目 12	試驗結果	試驗結果	規格要求
試驗項目 13	試驗結果	試驗結果	規格要求
試驗項目 14	試驗結果	試驗結果	規格要求
試驗項目 15	試驗結果	試驗結果	規格要求
試驗項目 16	試驗結果	試驗結果	規格要求
試驗項目 17	試驗結果	試驗結果	規格要求
試驗項目 18	試驗結果	試驗結果	規格要求
試驗項目 19	試驗結果	試驗結果	規格要求
試驗項目 20	試驗結果	試驗結果	規格要求

T-1は、100℃で30分間加熱処理した後130℃で10分間加熱処理を行なった時の可視光線(400～

【10048】美濃川116～202の対岸に2-7フェ
ル・ボキセン・シル・シルの2つあり、
ル・シル・シルを用いる以外は、実施例1と同様
にホログラムを制作し、平均透過率、回折効率、
変調を測定した。その評価結果を表4に示す。ただし、
【10049】
の平均透過率を測定したものである。
した後の可視光域(400～700 nm)におけるシー
のであり、またT-2は、さらに15.0℃で1時間加熱
* 700 nmにおけるシーの平均透過率を測定したも

深部(%)	膨大率 ($\mu\text{m}/\text{mm}^2$)	膨度 (μm)	R.L.C. X ($\times 100$)	L.C. (%)	T-2 (%)
深部(%)	膨大率 ($\mu\text{m}/\text{mm}^2$)	膨度 (μm)	R.L.C. X ($\times 100$)	L.C. (%)	T-2 (%)
D = -1	2.0	18.0	9.4	1.87	9.6
深部1	D = -1	2.0	18.0	9.4	1.87
D = -2	2.0	18.1	9.1	2.07	9.1
深部12	D = -2	2.0	18.1	2.07	9.1
D = -3	2.0	18.4	9.2	2.07	9.3
深部13	D = -3	2.0	18.4	2.07	9.3
D = -4	2.0	16.8	9.4	2.03	9.4
深部14	D = -4	2.0	16.8	2.03	9.4
D = -5	2.0	15.6	9.3	2.09	9.6
深部15	D = -5	2.0	15.6	2.09	9.6

率、屈折率調整については光あるいは熱などの外的作用によりスルホン酸誘導体を生じさせる化合物である。二トロペンシルトシリートを添加しない場合でもほとんど150℃に加熱処理した時点でさらには低下した。

【0053】

【表6】

比較例	屈折率 (n)	光透過率 (%)	D.L. (%)	R.L. (%)	T-2 (%)
比較例 1	1.54	94	2.03	6.3	5.4
比較例 2	1.54	91	2.01	6.2	5.4
比較例 3	1.47	93	2.23	6.3	6.1
比較例 4	1.57	92	2.10	5.7	6.1
比較例 5	1.53	85	2.25	6.1	5.5

※スチレインなどの極めて要求性能の高いホログラム光学素子 (HOB) 用の透明ホログラム用感光性記録材料に用

【図面の簡単な説明】

【図1】本発明の透明ホログラム用感光性記録材料からなる透明ホログラム用感光性記録媒体の構成を説明する

略図である。

【図2】ホログラム撮影用の二光束光学系を説明する略

略図である。

【符号の説明】

1 透明ホログラム用感光性記録媒体

基板

感光層

保護層

レザ

レーザ光

ミラー

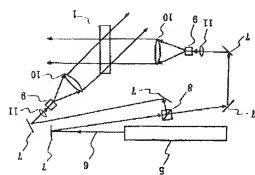
ビームスプリッタ

スミットリッパ

レンズ

レンズ

【図2】



【図1】



【発明の効果】以上述べたように本発明は、(A) 溶媒可溶性で、かつ常温で固体である樹脂と、(B) 常温、常圧で液体で、かつ常圧で沸点が100℃以上である重合を活性化し、(C) 化学作用放射線に露光するとラジカルノアールと、(D) 光開始剤と、(E) 光あるいは増感するアミノ基を有する増感色素と、(F) 光あるいは熱などの外的作用によりスルホン酸誘導体を生じさせる化合物から構成されることにより、とくに乾式処理において可視光域における高い透明性が得られるとともに、耐熱性など耐熱性に優れ、かつ化学的に安定したホログラムを提供することができ、とくにヘッドマウントディスプレイ※

【0054】<比較例1>実施例1において、二

トロペンシルトシリートを添加しないこと以外は同様に

ホログラムを複製し、さらに実施例と同程度の追色が生

じるように高圧水銀灯を用いて紫外光照射を行なったこ

ろ、10 J/cm² の光エネルギーを与えても可視光域

における平均透過率は

80%程度にとどまった。

【0055】

【発明の効果】以上述べたように本発明は、(A) 溶媒

可溶性で、かつ常温で固体である樹脂と、(B) 常温、

常圧で液体で、かつ常圧で沸点が100℃以上である

重合を活性化し、(C) 化学作用放射線に露光するとラジカル

ノアールと、(D) 光開始剤と、(E) 光あるいは増感するアミノ基を有する増感色素と、(F) 光あるいは熱などの外的作用によりスルホン酸誘導体を生じさせる化合物から構成されることにより、とくに乾式処理において可視光域における高い透明性が得られるとともに、耐熱性など耐熱性に優れ、かつ化学的に安定したホログラムを提供することができ、とくにヘッドマウントディスプレイ※

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Notes:

1. Untranslatable words are replaced with asterisks (***).
2. Texts in the figures are not translated and shown as it is.

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Dictionary: Last updated 09/09/2011 / Priority: 1. Chemistry / 2. Electronic engineering / 3. Mathematics/Physics

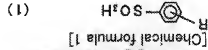
CLAIM + DETAILED DESCRIPTION

[Claim(s)]

[Claim 1] A photosensitive recording material for transparent holograms which enters a reference beam which is chemical action radiation coherent in a recording medium characterized by comprising the following, and object light which is the same radiation, forms an interference pattern, and creates a hologram.

Resin in which is essentially a solid in ordinary temperature and ordinary pressure at (A) solvent solubility.
 (B) A polymerization nature monomer which has at least one or more ethylenic unsaturated bonds whose boiling points it is a fluid in ordinary temperature and ordinary pressure, and are not less than 100 °* in ordinary pressure, and in which a radical polymerization is possible and from which a component (A) and a refractive index differ.
 (C) A photoinitiator which will activate a radical polymerization if it exposes in chemical action radiation.
 (D) An amino group which carries out sensitization of the photoinitiator (C).

[Claim 2] The photosensitive recording material for transparent holograms according to claim 1, wherein a sulfonic acid derivative generated by external actions, such as light or heat, is denoted by a following general formula (1).



(Among a formula, R substitutes an aromatic ring by one or more functional groups which consist of a hydrogen atom, an alkyl group, a halogen group, a nitro group, hydroxyl, cyano groups, amino groups, or alkoxy groups, and things are shown.)
 [Claim 3] A photosensitive recording medium for transparent holograms characterized by comprising the following.
 A photosensitive layer which applies on a substrate and dries a sensitizing solution which dissolved in a solvent and prepared the photosensitive recording material for transparent holograms according to claim 1.
 A protective layer.

[Claim 4] As opposed to a photosensitive layer of the photosensitive recording medium for transparent holograms according to claim 3, A manufacturing method of a transparent hologram which fades or decolorizes sensitizing dye which has said amino group with a sulfonic acid derivative generated from a compound which gives external actions, such as light or heat, and generates said sulfonic acid derivative after giving holographic exposure and forming a latent image, and is characterized by things.

[0001] [Detailed Description of the Invention]

[Industrial Application] This invention is used for volume phase type hologram formation, and is exposed by high sensitivity to visible light, especially visible light, such as argon laser radiation. And hologram characteristic values, such as resolution, diffraction efficiency, and transparency, are good, and are related with the photosensitive recording material for transparent holograms which further excellent in weatherability and preservation stability, the photosensitive recording medium for transparent holograms, and the manufacturing method of a transparent hologram using it.

[Description of the Prior Art] Conventionally, since regeneration of a three-dimensional solid image is possible for a hologram, it is used for the display of covers, such as books and a magazine, POP, etc., the gift, etc., from the outstanding design nature and the ornament effect. Since it can say that a hologram is equivalent to record of the information on a submicron unit, it is used for the mark for forgery prevention, such as negotiable securities and a credit card, etc.

[0003] Since especially the volume phase type hologram can modulate a phase, without absorbing the light beam which passes an image by forming the spatial interference fringe from which the refractive index instead of optical absorbance differs into a hologram recording medium. In recent years, the application to the hologram optical element (HOE) represented by the head up display (HUD) for automobile loading other than a display use is expected.

[0004] By the way, a volume phase type hologram recording material is exposed by high sensitivity to a laser beam with a visible oscillation wavelength, and it is required that high definition should moreover be shown. In actually using it for formation of a hologram, it is required that characteristics, such as diffraction efficiency of a hologram, the wavelength reproducibility of regenerated light, and a band width (regenerated light full width at half maximum), should suit the purpose. When above-mentioned head up display (HUD) etc. are used, importance is attached to having not only the above-mentioned hologram characteristics but higher transparency (light transmittance state). To excel in preservation stability over a long period of time is also needed.

[0005] The general principle about hologram production is written in some document and the technical books of Chapter 2, for example, a "holographic display" (the volume for Junpei Tsujuchi; Sangyo Toshio Publishing). According to these, it is put on the coherent position of two luminous flux which irradiates a recording object thing with one side of a laser beam, and can generally receive the total reflection light from it, photosensitive recording medium, for example, dry plate for photographs. Another coherent light other than the reflected light from a subject is directly irradiated by the recording medium, without hitting a subject. Object light and the light directly interference fringe of a reference beam and object light is recorded as picture information. Next, if the processed recording medium is put to light and observed in the position of a suitable eye, the object image which the light from an illumination light source was diffracted by the hologram so that the wave face of the reflected light which reached the recording medium first from the subject on the occasion of record might be reproduced, and resembled the real image of the subject as a result will be observed in three dimensions. The hologram which enters a reference beam and object light in a recording medium from the same direction, and is formed is known as a transmission type hologram. Generally the hologram which was entered and was mutually formed from the opposite side of a recording medium on the other hand is known as a reflection type hologram. A transmission type hologram can be obtained by a publicly known method which is indicated, for example in the US,3506272,B gazette, the US,3894787,B gazette, etc. A reflection type hologram is producible by the publicly known method indicated by the US,3532406,B gazette, for example.

[0006] Reflective index modulation occurs as a value which compares the hologram formed as an image. This is a value of the incident light diffracted by the diffraction grating specified from diffraction efficiency and the thickness of a recording medium namely [comparedatively], when the angle which two luminous flux makes with a medium directly similarly makes to a recording medium, and irradiates it and a diffraction grating is produced. Reflective index modulation is a quantitative measure of change of the refractive index produced in the exposure part of a volume type hologram and an unexposed part, i.e., the portion which light interferes and suits in slight strength, and the portion weakened mutually.

(H. Kogelnik).

Compared with a transmission type hologram, it is high-resolution, namely, generally, since a reflected phase type hologram has many interference fringes formed in per mm, it is difficult to record, and it is difficult to obtain high refractive index modulation.

[0007] There is the following as a recording material of such a volume phase type hologram. Conventionally, generally the sensitive material of a bleached treatment silver salt and a dichromated gelatin system is used, and the sensitive material of this dichromated gelatin system is a material most widely used for recording a volume phase type hologram with those high diffraction efficiency and low noise characteristics. By the way, in order this sensitive material has a short shelf life, to have to prepare to the degree which is production and to perform wet developing, it is not a sensitive material which modification of a hologram is produced in swelling and the contraction process of gelatin which it is needed in the case of hologram production, and a silver salt sensitized material needs complicated treatment after record bad [the reproducibility of a hologram], and can be satisfied from a viewpoint of stability and workability. In addition, each of these above-mentioned sensitive materials has the problem of being inferior to an environmental capability-proof, for example, moisture resistance, and weatherability.

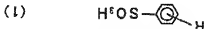
[0008] On the other hand, the hologram recording material using poly-N-vinylcarbazole as a material provided with the characteristics that it should excel in an environmental capability-proof, and should have hologram recording materials, such as high resolution and high diffraction efficiency, is raised. For example, the hologram recording material which consists of an annular α -disicobonyl compound and a sensitizer as a cross linking agent (JP, S60-45283A). The hologram recording material which consists of 1,4,5,6,7,7-hexachloro-5-norbornene anhydrous-2,3- α -disicobonyl acid and a pigment (JP, S60-227280A). The hologram recording material (JP, S60-260080A) which consists of 2,3-bornane dione and thioflavine T and iodoform, etc. are proposed. However, since these hologram recording materials need wet developing too, since it is the sensitive material which needs a complicated treatment process, and has the problem of being inferior to reproducibility, and made poly-N-vinylcarbazole base resin, it is chemical stability, and although excelled in high resolution and an environmental capability-proof, it crystallizes, and is very easy to whiten poly-N-vinylcarbazole, and the reproducibility of transparency has the problem that it will be bad and a solvent will also be restricted. In addition, still much more improvement is desired in the sensitivity characteristic. [0009] As a material which can carry out photo-curing by high sensitivity, it is a composition component of a photopolymerization initiator. The photopolymerization resin composition used in the combination of 3-keto coumarin and diaryliodonium salt (JP, S60-88005A). The hologram recording material (JP, H4-31590A) which combined polymethylmethacrylate as this photopolymerization initiator and a support polymer is proposed. Although it is chemically stable and has high resolution and high sensitivity, in order to make an opening form by a wet process, Since α -polymer dissolves in a swelling solvent a little in expansion of dispersion in the peak wavelength of a reproducing wave length, or the half band width of peak wavelength, and the case of development. Since it has the problem that development nonuniformly occurs easily and many openings exist in a hologram further, it has the problem of being inferior to a heat-resisting property and heat-resistant

pressure nature. [0010] Then, the photopolymerization type sensitive material can produce a hologram as indicated by the US,3993485,B gazette and the US,3658526,B gazette at 1 time of a treatment process without a wet process. The former has a sensitive material of two types and, [as the 1st example] reactivity and a refractive index — things — the combination of the unsaturated ethylenic monomer and photopolymerization initiator in which two polymerizations are possible. For example, it is a photosensitive resin composition which can carry out hologram recording by consisting of cyclohexyl methacrylate, N-vinylcarbazole, and benzoin methyl ether, sandwiching this in the glass plate of two sheets, and exposing by a 2 luminous—flux optical system. The unsaturated ethylenic monomer which has a comparable refractive index as the 2nd example and which can be polymerized and the unsaturated ethylenic monomer which works as a cross linking agent when it is polymerized, and a polymerization initiator. For example, it is a photosensitive resin composition of two monomers, the nonresponsive compound which differs in a refractive index, and a polymerization initiator. For example, it is a photosensitive resin composition which consists of butyl methacrylate, ethylene glycol dimethacrylate, 1-phenylacetylene, and benzoin methyl ether, and can produce a hologram like the 1st example. Even if it uses which photosensitive resin composition, the polymerization of a reactant high monomer progresses more in the portion to which the light intensity of the interference fringe made according to two luminous flux becomes strong, and. The concentration gradient of a monomer arises and a reactant high monomer diffuses a reactant low monomer or nonresponsive compound into a portion with strong light intensity again at a portion with weak light intensity. Thus, an interference fringe is recorded with the difference of a refractive index, and a volume phase type hologram is formed. [0011] The latter US,3658526,B gazette [The manufacturing method of the stable hologram which consists of a hologram recording material which blended the fluid monomer, the ethylenic monomer in which photopolymerization is possible, and the photopolymerization initiator into the polymer matrix is indicated, and an external volume phase type hologram is obtained by 1-time exposure of chemical action radiation. The complete exposure of the continuing chemical action radiation is fixed to the hologram formed. [0012] It is indicated by the US,4942112,B gazette, the US,5098803,B gazette, JP,H2-3081,A, and JP,H2-3082,A as improvement are also including the manufacturing method of the hologram recording material indicated by the US,3658526,B gazette. Thermoplastics, the unsaturated ethylenic monomer which can be polymerized, and a photopolymerization initiator are made into basic composition at these, in order to raise a refractive index modulation, it is made to become refractive index difference as either the thermoplastics or the unsaturated ethylenic monomer which can be polymerized using the compound which has an aromatic ring. [like that by which the US,3658526,B gazette indication is carried out] Since many light exposures are needed and high diffraction efficiency cannot be acquired from restriction of the diffusibility of the monomer at the time of exposure by using resin of the amount of polymers as binder MATORIKUSSU, the nonresponsive plasticizer has been added. [0013] According to JP,H5-107999,A, what blended the cation pile affinity monomer and the cationic initiator instead of the plasticizer in the above—mentioned patent is proposed. The photosensitive resin composition for hologram recording which consists of an epoxy resin, a radical polymerization nature unsaturated ethylenic monomer, and an optical radical polymerization agent is indicated by JP,5-94014,A. [0014] [Problem to be solved by the invention] the above—mentioned recording material of a volume phase type hologram [The problem etc. of the preservation stability by addition of the problem of the polymerization nature of the monomer for obtaining refractive index modulation, or dispersibility, the carrier which supports a monomer, and a nonresponsive additive. Although it furthermore has a problem of hologram characteristics, such as workability in hologram production, diffraction efficiency of the hologram obtained, transparency, and reproducibility, respectively,

[photopolymerization type sensitive material **** especially using a dry developing method] In order that the sensitizing dye used as problem common to all at the time of hologram formation may remain in a system as it is, there is a problem used as the colored hologram and it has been a serious problem in the use of optical elements, such as a head up display (HUD) in which high permeability is demanded especially. Then, while the hologram formation by dry processing is possible for this invention and being high transparency, it excels in weatherability. And it aims at providing the transparent hologram photosensitive recording material excellent in high resolution, high diffraction efficiency, and reproducing wave length reproducibility, a transparent hologram photosensitive recording medium, and the manufacturing method of a transparent hologram using it. [0015]

[Means for solving problem] the photosensitive recording material for transparent holograms, wherein this invention consists of sensitizing dye and a compound which generates a sulfonic acid derivative by external actions, such as (E) light or heat. [It is made that an aforementioned problem is solved by comprising the following should be solved, and, [the invention according to claim 1] The photosensitive recording material for transparent holograms which enters the reference beam which is coherent chemical action, radiation, and the object light which is the same radiation into a recording medium, forms an interference pattern, and creates a hologram. Resin in which is essentially a solid in ordinary temperature and ordinary pressure at (A) solvent solubility, (B) The polymerization nature monomer which has at least one or more ethylenic unsaturated bonds whose boiling points it is a fluid in ordinary temperature and ordinary pressure, and are not less than 100 °C in ordinary pressure, and in which a radical polymerization is possible and from which a component (A) and a refractive index differ. (C) The photoinitiator which will activate a radical polymerization if it exposes in chemical action radiation. (D) The amino group which carries out sensitization of the photoinitiator (C).

[0016] The compound in which the invention according to claim 2 generates a sulfonic acid derivative in the photosensitive recording material for transparent holograms of Claim 1 is denoted by a following general formula (1).



(Among a formula, R substitutes an aromatic ring by one or more substituents which consist of a hydrogen atom, an alkyl group, a halogen group, a nitro group, hydroxyl, cyano groups, amino groups, or alkoxy groups, and things are shown.) [0017] It is a photosensitive recording medium for transparent holograms which the invention according to claim 3 provides the photosensitive layer which applies on a substrate and dries the sensitizing solution which dissolved in the solvent and prepared the photosensitive recording material for transparent holograms according to claim 1, and a protective layer, and is characterized by things. [0018] The invention according to claim 4 receives the photosensitive layer of the photosensitive recording medium for transparent holograms according to claim 3. After giving holographic exposure and forming a latent image, external actions, such as light or heat, are given, it is a manufacturing method of the transparent hologram which fades or decolorizes the sensitizing dye which has said amino group with the sulfonic acid derivative generated from the compound which generates said sulfonic acid derivative, and is characterized by things. [0019]

[Function] in this invention, although the aliphatic series monomer (B) in which a radical

polymerization is possible is uniformly distributed over resin (A) which is a solid in ordinary temperature and ordinary pressure by solvent solubility, it irradiates this recording material with laser interference light.

With therefore, the radical polymerization active species which the photoinitiator (D) produced from the photoinitiator (D) in the operation of sensitizing dye (C) in the strong part of the light interference operation in a laser radiation part. Since an aliphatic series monomer (B) polymerizes, it follows on polymerizing and the density difference arises, an aliphatic series monomer (B) carries out spreading diffusion from the circumference.

That is, in the strong part of the light interference operation in a laser radiation part, monomer concentration becomes high, and it becomes low in the weak part of the light interference operation in a laser radiation part. Resin (A) is extruded by the weak part of the light interference operation in a laser radiation part, the concentration in the portion becomes high, and the concentration in the strong part of the light interference operation in a laser radiation part falls. Thereby, since refractive index difference is produced in both parts, the latent image of a hologram is recorded.

[0020] and the thing for which external actions, such as light or heat, are given after hologram formation by adding the compound (E) which generates a sulfonic acid derivative by external actions (D) which has this amino group that remains in a recording medium fades and decolorizes with a sulfonic acid derivative. [namely the sensitizing dye (D) currently added into the photosensitive recording material] Since the compound (E) which generates the sulfonic acid derivative added beforehand generates a sulfonic acid derivative by external actions, such as light and heat, and the amino group of sensitizing dye (D) is formed into a class by this, in order for the absorption wavelength region of sensitizing dye (D) to shift to the short wavelength side and to move to an ultra-violet wave length region, fading and the discharge in a visible region (400-700 nm) arise. The sensitizing dye (D) which has the amino group formed into a class is excellent in weatherability and preservation stability, in the preservation over a long period of time, coloring does not take place by decomposition etc., but the stable transparent hologram is obtained.

[0021] [0021]. As for the feeling for transparent holograms of this invention, a recording material is ***** of refractive index modulation, diffraction efficiency, the peak wavelength of regenerated light, and its band width.

Application to the hologram optical element as which high transparency, such as a head up display, is required since it excels and the environmental capability-proof is also further excellent.

[0022]

[Working example] Hereafter, this invention is explained in detail. Drawing 1 is a schematic diagram explaining the composition of the photosensitive recording medium for transparent holograms which consists of a photosensitive recording material for transparent holograms of this invention, and drawing 2 is an approximate account figure explaining the 2 luminous-flux optical system for reflection type hologram photography.

[0023] [the component (A) solvent solubility which constitutes the photosensitive recording material for transparent holograms of this invention] [as resin in which is a solid in ordinary temperature and ordinary pressure] For example, polymethacrylic acid ester, polyacrylic acid, and those partial hydrolyzates, Polyvinyl acetate, polystyrene, polyvinyl butyral, polyvinyl acetate, Polyvinyl formal, polyvinyl acetate, polychloroprene, Polyvinyl chloride, cellulose acetate butyrate, Methyl cellulose, ethyl cellulose, chlorinated polyethylene, chlorinated polypropylene, Poly-N-vinylcarbazole, Poly-N-vinyl pyrrolidone, vinyl polyacetic acid / acrylate, Vinyl polyacetic acid / methacrylate, ethylene/vinyl acetate copolymer, and styrene, Maleic anhydride, acrylic acid, methacrylic acid, acrylic acid, acrylic ester. The thermoplastics represented by the copolymer etc. which consists of copolymerizable monomers, such as methacrylic acid ester, acrylamide, and methacrylamide, Bisphenol A and bisphenol A D, the bisphenol B, bisphenol A F, the bisphenol S,

novolak, o-cresolnovolak, it is represented by the epoxy resin generated by the condensation reaction of various phenolic compounds, such as p-allylphenol novolak, and epichlorohydrin, and a thermosetting resin is mentioned. Using also except above mentioned resin is possible, and it is not limited to these. By such solvent solubility, two or more kinds may be mixed and resin in which is a solid in ordinary temperatures and ordinary pressure may be used.

[0024] it has at least one or more ethylenic unsaturated bonds whose boiling points it is a fluid in component (B) ordinary temperatures and ordinary pressure, and are not less than 100 °C in ordinary pressure and in which a radical polymerization is possible. And as a polymerization nature monomer from which a component (A) and a refractive index differ, at least one or more unsaturated bonds of ethylene nature may be included in a structural unit, a polyfunctional vinyl monomer other than the vinyl monomer which is one organic functions may be included, and they may be these mixtures. It is desirable for there to be 0.03 or more refractive index difference of a component (A) and a component (B) by the theory of KOGURE n_D nik (H. Kogelnik) mentioned above in fact.

[0025] Specifically Acrylic acid (meta), maleic acid, acrylicamide (meta). [high boiling point vinyl monomers, such as diacetone acrylamide and 2-hydroxyethyl (meta) acrylate, and a par] [triethylene glycol, tetraethylene glycol, propylene glycol, dipropylene glycol, tripropylene glycol, a tetrapropylene glycol, Neopentyl glycol, 1,3-propanediol, 1,4-butanediol, 1,5-pentanediol, 1,6-hexanediol, 1,10-Decanediol, Trimethylolpropane, pentaerythritol, dipentaerythritol, ul or poly(meta) acrylic ester, such as sorbitol and mannitol. Or allycyclic polyhydroxy compounds and aromatic polyhydroxy compounds, such as dimethylol tricyclodecane monoacrylate and dimethylol tricyclodecane diacrylate, F. For example, ul or poly(meta) acrylic ester, such as hydroquinone, resorcinol, catechol, pyrogallol, and bisphenol A. The ethylene oxide denaturation (meta) acrylic ester of isocyanuric acid, 2-phenoxy ethyl methacrylate, phenol ethoxy rate monoacrylate, p-chlorophenyl acrylate, KAYARAD-R551 (made by trade name Nippon Kayaku Co., Ltd.), etc. are mentioned.

[0026] as a photoinitiator system which will activate a radical polymerization if it exposes in the component (C) chemical action radiation of this invention [Macromolecules, 10, a compound given in 1307(1977). For example, diphenyliodonium, ditriyl iodonium, phenyl (p-arsyl) iodonium, Bis(m-nitrophenyl)iodonium, bis(p-tert-butylphenyl)iodonium, ditriyl phenylphenyl)iodonium, such as bis(p-chlorophenyl)iodonium, Bromide or Howe fluoride salt, a hexafluorophosphate salt, iodonium salt, arene complex, etc., a tert-butyl peroxide iso-pig rate, 2,5-bis-(benzoyldioxy) hexane, 1,4'-bis[alpha-(tert-butyl dioxy)-iso-propoxy] benzene, Di-tert-butyl peroxide, 2,5-dimethyl-2,5-bis(tert-butyl dioxy)-hexamethylene peroxide, alpha-(iso-propylphenyl)-iso-propylhydroperoxide, 2,5-bis(methylcyclohexanone, tert-butyl hydroperoxide, 1,1-bis(tert-butyl dioxy)-3,3,5-bis-methylcyclohexanone, Butyl-4,4-bis(tert-butyl dioxy)valerate, cyclohexanone peroxide, 2,2',5,5'-tetra(tert-butylperoxy carbonyl) benzophenone, 3,3',4,4'-tetra(tert-butylperoxy carbonyl) benzophenone, 3,3',4,4'-tetra(tert-butylperoxy carbonyl) benzophenone, Organic peroxide, such as tert-butylperoxy benzoate and di-tert-butyl diperoxy hexylperoxy carbonyl) benzophenone, 3,3'-bis(tert-butylperoxy carbonyl)-4,4'-dicarboxy isophthalate, Quinone, such as 9,10-ANSURA quinone, 1-benzanthraquinone, and benzoin methylenbenzoin, etc. can be mentioned

[0027] as component (D) sensitizing dye which has one or more kinds of amino groups which carry out sensitization of the photoinitiator (C) of this invention [Specifically Rhodamine B, Crystal Violet, brilliant Gais RUBURU, neutral red, CHIONIN, methylene blue, an indigo, PINASHI and, tetraphenylporphyrin, A 3,3'-carbonyl screw (7'-diethylamino coumarin), 3-(2'-benzothiazole)-7-

(Among a formula, R substitutes an aromatic ring by one or more substituents which consists of a hydrocarbon group, an alkyl group, a halogen group, a nitro group, hydroxyl, cyano groups, amino groups, or alkoxy groups, and such things are shown)

[0029] As a compound of a component (E), specifically Diphenyliodonium trifluoro MESHSRETO, 4-methoxy diphenyliodonium trifluoro MESHSRETO, bis(4-tert-butylphenyl)iodonium trifluoro MESHSRETO, Diphenyliodonium MESHSRETO, 4-methoxy diphenyliodonium MESHSRETO, Bis(4-tert-butylphenyl)iodonium MESHSRETO, diphenyliodonium MESHSRETO, 4-methoxy diphenyliodonium MESHSRETO, Bis(4-tert-butylphenyl)iodonium MESHSRETO, 4-methoxy diphenyliodonium MESHSRETO, benzoin triphenylsulfonium trifluoro MESHSRETO, 4-fluoro triphenylsulfonium trifluoro MESHSRETO, benzoin triphenylsulfonium trifluoro MESHSRETO, 4-methoxy triphenylsulfonium trifluoro MESHSRETO, 4-methyl triphenylsulfonium trifluoro MESHSRETO, 2-nitrobenzyl tosylate, 4,5-dimethoxy-2-nitrobenzyl tosylate, difenylsulfon, 3-(p-tolyl) disulfon, (made by a green chemicals company), DAM-201 (made by a green chemicals company), PI-105 (made by a green chemicals company), NDI-105 (made by a green chemicals company), NA1-105 (made by a green chemicals company), Diphenyliodonium anthracene sulfonate, p-nitrobenzyl 9,10-dithio anthracen-2-sulfonate, p-nitrobenzyl 9,10-dimethoxanthracene-2-sulfonate, Benzyl p-chlorobenzenesulfonate, Benzyl m-chlorobenzenesulfonate, Benzyl p-cyanobenzenesulfonate, Benzyl m-chlorobenzenesulfonate, Benzyl p-chlorobenzenesulfonate, Benzyl p-bromobenzenesulfonate, p-chlorobenzyl tosylate, p-chlorobenzenesulfonate, p-bromobenzenesulfonate, m-bromobenzenesulfonate, ethylbenzyl p-chlorobenzenesulfonate, benzyl tosylate, p-hydroxybenzyl tosylate, m-hydroxybenzyl tosylate, p-methoxybenzyl tosylate, m-methoxybenzyl tosylate, p-methylbenzyl tosylate, m-methylbenzyl tosylate, p-nitrobenzyl tosylate, p-nitrobenzenesulfonate, m-nitrobenzyl tosylate, p-bromobenzenesulfonate, etc. can be mentioned.

[0030] The sulfonate obtained at the reaction of not the thing limited to these but an alcohol corresponding generally and acid chloride of sulfonic acid derivatives, such as p-tolyl chloride and methylenesulfonyl chloride, can also be used. These may be used combining two or more kinds. [0031] [the sensitization thermal recording material for transparent holograms of this invention] As described above, by solvent solubility by (A) solvent solubility at resin which is a solid in ordinary temperature and ordinary pressure, and (B) ordinary temperature and ordinary pressure with a fluid. And the polymerization nature monomer where a boiling point has at least one or more ethylenic unsaturated bonds which are not less than 100 **, and in which a radical polymerization is possible by ordinary pressure and which differs in resin (A) and a refractive index. (C) The photoinitiator which will activate a radical polymerization if it exposes in chemical action radiation. (D) It consists of sensitizing dye which has an amino group which carries out sensitization of the photoinitiator (C), and a compound which generates a sulfonic acid derivative by external action, such as (E) light or heat. [the mixing ratio of resin (A) and a polymerization nature monomer (B)] Since the monomer amounts in which resin (A) polymerizes in holographic exposure according being superfluous to a laser run short, high refractive index modulation is not obtained. [the monomer which remains in a system without a polymerization nature monomer (B) polymerizing that it is superfluous in the first holographic exposure] Since a polymerization is caused, the interference fringe of the once formed hologram is confused and high refractive index modulation may not be obtained being spread in a manufacturing process, about the mixed rate, it needs to be careful. [combination / resin (A) for obtaining a bright hologram, and / of a polymerization nature monomer (B)] [The US,4942112,B JP,5-107999,A, JP,H5-94014,A, Or it is indicated to Tokuganhei6-46742 by these people, Tokuganhei6-149796, Tokuganhei6-149797, Tokuganhei6-149798, Tokuganhei6-148244, Tokuganhei6-148245, Tokuganhei6-178812, etc. The quantity of the photoinitiator of a component (C) is 1 to 10 weight sections from 0.1 preferably 20 weight sections to component (A) 100 weight section. The sensitizing dye of a component (D) can take the ranges from 0.5 to 5 from 0.1 preferably 10 weight sections to component (A) 100 weight section. Thus, each component of the sensitization thermal recording material for transparent holograms is chosen suitably. The sensitizing solution mixed and obtained at an arbitrary rate A spin coater, a roll coater, Using publicly known coating means, such as bar coater, a glass plate and a polycarbonate plate, it is the photosensitive recording medium 1 for transparent holograms for the usual hologram photograph which the hologram which was applied in the shape of a coat on the substrates 2, such as a polymethylmethacrylate board and polyester film, shows to drawing 1 is produced. Furthermore on the photosensitive layer 3, the protective layer 4 may be formed as an oxygen interception film. To the protective layer 4, for example, what is equivalent to the above-mentioned substrates 2 or polyolefin, it is formed of the coating etc. of the lamination by pasting, excluders, etc., which pinch a photosensitive layer using a transparent thin optically, such as plastics, such as polyvinyl chloride, polyvinylidene chloride, polyvinyl alcohol, or polyethylene terephthalate, and glass, or a solution. When applying a sensitizing solution, it may dilute with a suitable solvent if needed, but desiccation is required after applying on a substrate in that case. [0033] Furthermore, various additives, such as publicly known thermal-polymerization inhibitor, a chain transfer agent, and an antioxidant, may be added to the sensitization thermal recording material for transparent holograms of this invention if needed. [0034] Drawing 2 is a schematic diagram explaining the 2 luminous-flux optical system for reflection type hologram photography, and the laser beam 5 oscillated from the laser 5 is irradiated by the medium 1 for hologram recording via the mirror 7, the beam splitter 8, the spatial filter 9, and the lens 10. In this invention, dry processing (light irradiation and/or heat treatment) is performing the fixing process after the hologram photography by exposure. Although this invention does not carry out detailed explanation and illustration, it is possible similarly about production of a transmission type hologram, and the transmission type hologram which has outstanding hologram characteristics

is obtained.

[0035] Although a helium cadmium laser, an argon laser, a krypton laser, a helium neon laser, etc., can be used as a light source suitable for the photosensitive recording material for transparent holograms of this invention in the exposure process of an interference pattern, it is not limited to this.

[0036] As a means for furthermore generating a sulfonic acid derivative by an external action after hologram production.] Although there are heating by full exposure, oven, a hot plate, etc. by high pressure mercury vapor lamp, low pressure mercury lamp, xenon lamp, carbon arc light, ultraviolet pressure mercury lamp, a halide lamp, etc., it is not limited to this. Two or more kinds of these methods may combine. As an external action, it is what is called an external stimulus, and there are an acid specific in addition to light and heat etc.

[0037] When recording a hologram image on this photosensitive recording medium 1 for transparent holograms, by adding laser radiation according to a desired picture, [the strong part of a light interference operation of a laser radiation part.] By the ordinary temperature and ordinary pressure at which are uniformly distributed by ordinary temperature and ordinary pressure at solvent solubility in resin (A) which is a solid, with a fluid, and a boiling point has at least one or more ethylenic unsaturated bonds which are not less than 100 μm and in which a radical polymerization is possible by ordinary pressure. And if the polymerization nature monomer (B) from which a component (A) and a refractive index differ makes it expose by laser (laser interference light) exposure, in order that it may polymerize and it may polymerize according to an operation of a photopolymerization initiator, movement of the polymerization nature monomer (B) in which the radical polymerization of the laser circumference is possible arises. For this reason, [the strong part of the light interference of a laser radiation part.] The concentration of the polymerization nature monomer (B) in which a radical polymerization is possible becomes high, and [the weak part of a light interference operation.] Since the concentration of the polymerization nature monomer (B) in which a radical polymerization is possible falls, the refractive index modulation by refractive indices differing arises from the density difference of the strong part of the light interference of the photosensitive recording medium 1 for transparent holograms, and the weak part of a light interference operation, and

hologram image record is performed. The compound (E) which generates the sulfonic acid derivative added beforehand and the sensitizing dye (D) which has this amino group that furthermore remains in the recording medium after hologram formation light. In order for the absorption wavelength region of sensitizing dye (D) to shift to the short wavelength side since the amino group of sensitizing dye (E) is formed into a class with the sulfonic acid derivative generated by external actions, such as heat, and to move to an ultra-violet wave length region, fading and the discharge in a visible region (400-700 nm) arise. The sensitizing dye (D) which has the amino group formed into a class is excellent in weatherability and preservation stability, in the preservation over a long period of time, coloring does not take place by decomposition etc., but the stable transparent hologram is obtained.

[0038] Hereafter, a concrete working example explains this invention still in detail.

<Working-example 1> bisphenol A type epoxy resin (made by trade name "Epicat 1007" oil recovery shell epoxy company) 100 weight section, Triethylene glycol-diacylate 50 weight section and diphenylidonium hexafluorophosphate 5 weight section, What carried out the mixture solution of 3,3'-carbonyl bis(7-diethylamino)coumarin 1 weight section and the 2-nitrobenzyl tosylate 5 weight section to 2-butanone 200 weight section was used as the sensitizing solution. After having applied this sensitizing solution to the glass substrate so that it might become about 15 micrometers of thickness, and forming a photosensitive layer, the photosensitive layer top was covered by the polyvinyl alcohol (PVA) film, and the photosensitive recording medium 1 for transparent holograms was produced.

[0039] After exposing the photosensitive recording medium 1 for transparent holograms according to the 2 luminous flux optical system for hologram photography shown in drawing 2, using argon laser (514.5 nm, light exposure 20mJ/cm²) as a light source and producing a hologram image, heat-

treatment was performed at 100 μm for 30 minutes. In order to carry out the photolysis of the 2-

[0040] 90% was shown when average permeability [in / for the obtained hologram / a light region

and after 60%T. The diffraction efficiency of the hologram was measured with the

and the time of receiving direct incident light without placing a sample was made into diffraction

5) working example 1, a 3,3'-carbonyl screw (7-diethylamino coumarin) (Dye-2), 2,5-screw [phenyl

with the result of the working example 1. However, T-1 measures the average permeability of the

[Table 1]

[Table 1]

测试色标 (D)	亮度 (lm/ft ²)	照度 (lx)	B.E. (%)	R.L.C. (× 100)	色度 (Munsell)	
					T-1 (%)	T-2 (%)
测试列 1	2.0	16.8	9.4	2.04	9.0	9.0
Dy-e-2	2.0	14.3	9.2	2.22	9.1	9.0
测试列 3	2.0	15.4	9.4	2.22	9.5	9.4
Dy-e-4	2.0	17.5	9.5	2.04	9.1	9.2
测试列 5	2.0	15.7	9.7	2.54	9.7	9.6

[[[phenyl/ 4--(dimethylamino)--/ methylene] cyclohexanone Dye-5:3-ethyl-5-[2-(3-ethyl-2-

produced like the working example 1 and average permeability, diffusion efficiency, and refractive

2 measures the average permeability of the sheet in the light region (400–700 nm) after heating at 150 more ** for 1 hour.

[0045] Table 2]

透色率(D)	透光率 (nm/cm ²)	厚度 (μm)	D.E. (%)	R.L.C. (%)	T-1 (%)	T-2 (%)
実験例 6	Dy e - 1	2.0	15.4	9.1	2.02	9.2
実験例 7	Dy e - 2	2.0	15.1	9.4	2.24	9.2
実験例 8	Dy e - 3	2.0	15.2	8.8	1.95	9.5
実験例 9	Dy e - 4	2.0	16.3	9.6	2.32	9.0
実験例 10	Dy e - 5	2.0	14.8	9.3	2.22	9.7

[0046] Except using p-methoxybenzyl tosylate instead of 2-nitrobenzyl tosylate of the <working-example 11-15> working examples 1-5, the hologram was produced similarly. When p-methoxybenzyl tosylate was used instead of 2-hydroxy tosylate, heat-treatment was performed for 10 minutes at 130 ** instead of the light irradiation by a high pressure mercury vapor lamp, and the sulfonic acid derivative (p-toluenesulfonic acid) was made to generate. This measured the average permeability of TO of a hologram, diffraction efficiency, and refractive index modulation similarly. This is shown in Table 3. However, T-1 measures the average permeability of the sheet in a light region (400–700 nm) when heat-treatment is performed for 10 minutes at 130 ** after heat-treating for 30 minutes at 100 **. T-2 measures the average permeability of the sheet in the light region (400–700 nm) after heating at 150 more ** for 1 hour.

[0047] Table 3]

透色率(D)	透光率 (nm/cm ²)	厚度 (μm)	D.E. (%)	R.L.C. (%)	T-1 (%)	T-2 (%)
実験例 1	Dy e - 1	2.0	19.0	9.4	1.87	9.0
実験例 2	Dy e - 2	2.0	14.5	9.1	2.06	9.1
実験例 3	Dy e - 3	2.0	18.1	9.6	2.07	9.3
実験例 4	Dy e - 4	2.0	16.8	9.4	2.03	9.4
実験例 5	Dy e - 5	2.0	15.6	9.3	2.09	9.6

[0048] Except using 2-phenylethyl tosylate instead of p-methoxybenzyl tosylate of the <working-example 16-20> working examples 11-15, the hologram was produced like the working example 11 evaluation result is shown in Table 4. However, T-1 measures the average permeability of the sheet in a light region (400–700 nm) when heat-treatment is performed for 10 minutes at 130 ** after heat-treating for 30 minutes at 100 **. T-2 measures the average permeability of the sheet in the light region (400–700 nm) after heating at 150 more ** for 1 hour.

[Table 4]

[0050] In the comparative example 1-5, except not adding 2-nitrobenzyl
refractive index modulation were measured similarly. The evaluation result is shown in Table 5.
However, T-1 measures the average permeability of the sheet in the light region (400-700 nm) after
heat-treating for 30 minutes at 100 **, and, T-2 [The average permeability of the sheet in the
light region (400-700 nm) after heating at 150 more **, for 1 hour is measured. Even when these do
not add 2-nitrobenzyl tosylate which is diffraction efficiency and a compound which generates a
sulfonic acid derivative by external actions, such as light or heat, about refractive index modulation,
change is hardly seen, but The big difference was produced in transparency, when not adding, the
light transmittance state was low 20 to 30%, and when heat-treated especially at 150 **, it fell
further.

[0051] [Table 5]

增感系数(D)	曝光量 [mJ/cm ²] (m)	密度 D.E	R.L.C			T-1			T-2		
			(%)	(%)	(×100)	(%)	(%)	(%)	(%)		
灵敏度 16	D.E-1	2.0	15.4	9.4	2.22	9.2	9.4	9.2	9.2	9.2	9.2
灵敏度 17	D.E-2	2.0	15.2	8.8	1.94	9.3	9.4	9.3	9.4	9.4	9.4
灵敏度 18	D.E-3	2.0	18.1	9.6	2.07	9.7	9.6	9.7	9.6	9.6	9.6
灵敏度 19	D.E-4	2.0	15.6	9.2	2.11	9.5	9.4	9.5	9.4	9.4	9.4
灵敏度 20	D.E-5	2.0	16.8	9.3	2.01	9.2	9.2	9.2	9.2	9.2	9.2

	増感色基 (D)	増光量 (ml/cm ²)	濃度 (μm)	D.B. (%)	R.L.C. (× 100)	T-1 (%)	T-2 (%)
比較例 6	Dye-1	2.0	16.8	9.4	2.03	63	5.4
比較例 7	Dye-2	2.0	15.4	9.1	2.01	62	5.4
比較例 8	Dye-3	2.0	14.7	9.3	2.23	69	6.1
比較例 9	Dye-4	2.0	15.7	9.2	2.10	57	5.1
比較例 10	Dye-5	2.0	15.8	9.5	2.25	61	5.5

[0054] In the <comparative example 11> working example 1, a hologram is similarly produced except not adding 2-methylbenzoyl tosylate. When light irradiation was performed using the high pressure mercury vapor lamp so that fading still more nearly comparable as an working example might arise, even if it gave the light energy of 10 J/cm², the average permeability of the sheet in a light region (400-700 nm) was only about 80%.

[Effect of the invention] [Effect of the invention] with, this invention being a fluid and with (A) solvent solubility in resin which is a solid obtaining in this invention, and (B) ordinary temperature and ordinary pressure, [this invention] [ordinary temperature and ordinary pressure] And the polymerization nature monomer where a boiling point has at least one or more ethylenic unsaturated bonds which are not less than 100 **, and in which a radical polymerization is possible by ordinary pressure and which differs in a component (A) and a refractive index, (C) The photoinitiator which will activate a radical polymerization if it exposes in chemical action radiation, the sensitizing dye which has an amino group which carries out sensitization of the (D) photoinitiator (C), and the compound which generates a sulfonic acid derivative by external actions, such as (E) light or heat. therefore, **** -- the hologram which was excellent in weatherability, such as a heat-resisting property, and was chemically stabilized while the high transparency in a light region was acquired by things especially in dry processing -- *****.

It can use for photosensitive recording materials for transparent holograms for hologram optical elements (HOE) with very high demand and performance, such as a head up display, especially.

[Translation done.]